Update on Hake MSE

JMC meeting

March 2019

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Outline

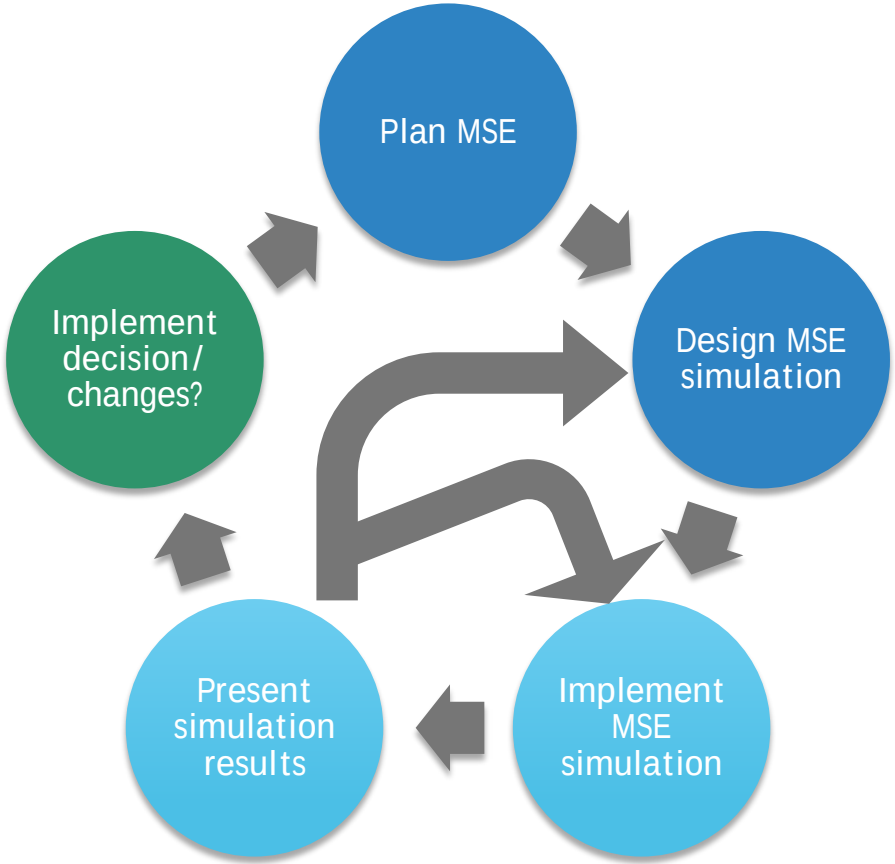
- Review MSE context and events of the past year
- Work plan and timeline
  - Work plan elements
  - Progress on each element
  - Next steps

Reminder: MSE is a process meant to improve strategic decision making

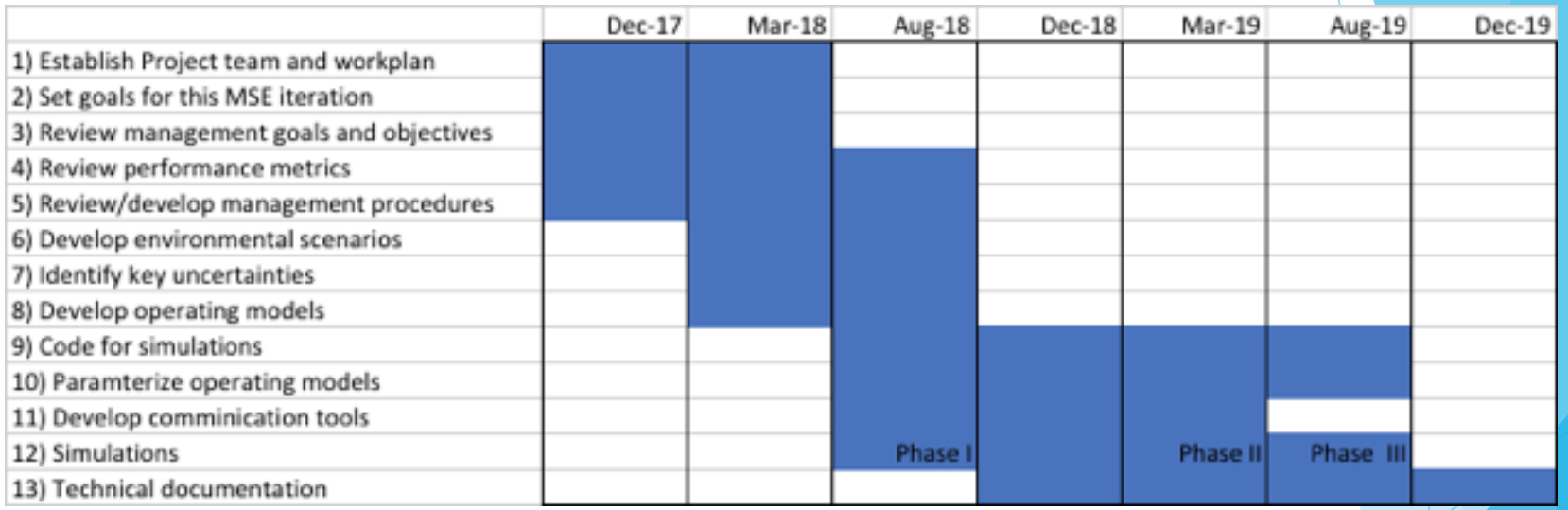
- Testing the performance of management procedures (data collection, assessment, application of harvest strategies) over:
  - Many replicate “futures”
  - Future scenarios capturing “things we can’t control”, e.g. changes in productivity, recruitment, natural mortality, spatial distribution
  - Alternative hypotheses about how the fishery system functions
- Testing management procedures first in a virtual world, before considering implementing them the real world is part of due diligence
- MSE is not meant to inform tactical decision-making
- Communication throughout the process is key

Events of the past year

- **February 2018**: draft MSE work plan reviewed by SRG
- **March 2018**: MSE work plan discussed at JMC meeting in Lynnwood
- **May-June 2018**: MSE working group phone calls
  - Call #1: Specifying Objectives and Performance Metrics
  - Call #2: Generating hypotheses for MSE operating models and FATE hake project
  - Call #3: Prioritizing scenarios for the MSE
- **July 2018:** JMC meeting in Victoria focused on MSE
- **October/December 2018**: JMC phone call to follow up objectives and performance metrics
- **December 2018**: JTC meeting included update on MSE progress
- **February 2019**: review of MSE progress at SRG


Plan MSE
Design MSE simulation
Implement MSE simulation
Present simulation results
Implement decision/ changes?

Overview timeline for MSE tasks



Plan and Design I

1. **Establish project team and MSE Work group, roles and responsibilities, communication strategies, work plan**
2. **Establish goals for this iteration of the MSE (What problem are we trying to address?)**
   - **JMC's stated MSE goals:**
     - Evaluate the performance of current hake management procedures under alternative hypotheses about current and future environmental conditions
     - Better understand the effects of hake distribution and movement on both countries' ability to catch fish
     - Better understand how fishing in each country affects the availability of fish to the other country in future years

Plan and Design II

3. Review goals and objectives of managers with feedback from MSE working group (iterative process)
4. Review performance metrics with feedback from MSE working group (iterative process)
5. Develop environmental scenarios
6. Identify other types of scenarios (?)
7. Develop operating and estimation models

5/6. Develop scenarios

Current steps include:

- Incorporate age-based movement between 2 areas

Planned steps include:

- Incorporate the findings of Mike Malick's work under the Fisheries And The Environment (FATE) project
- Modeling trends and/or regime-like patterns of variability in movement

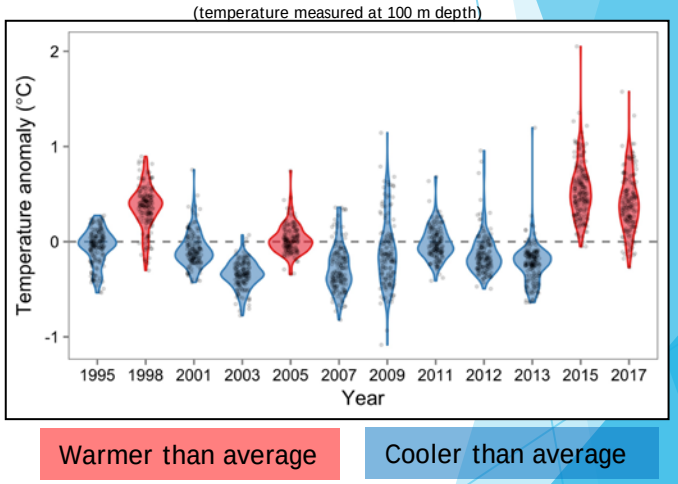
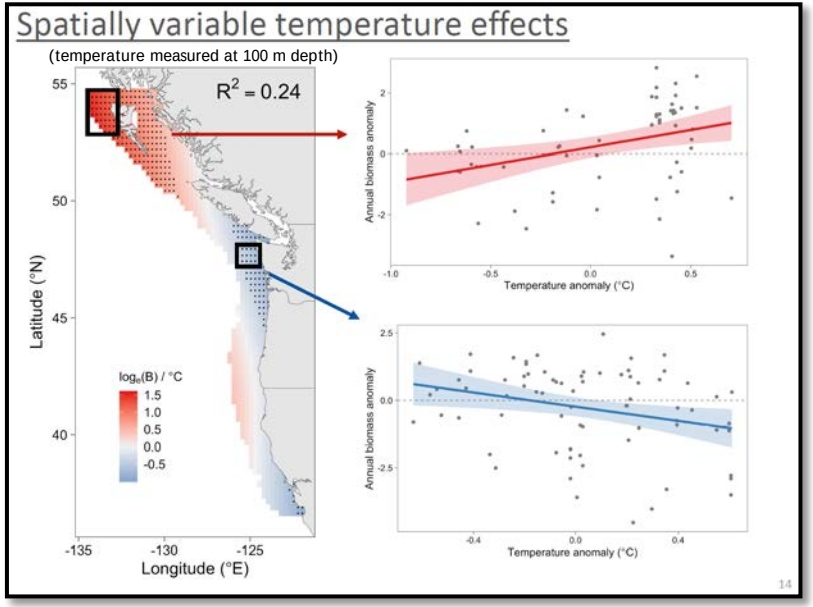
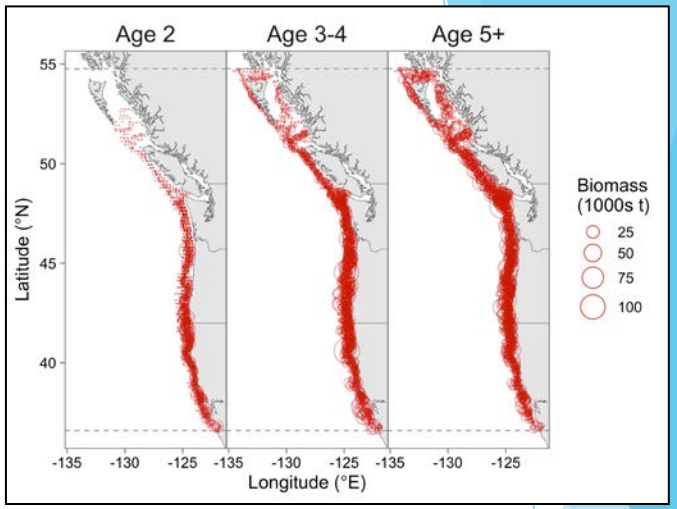


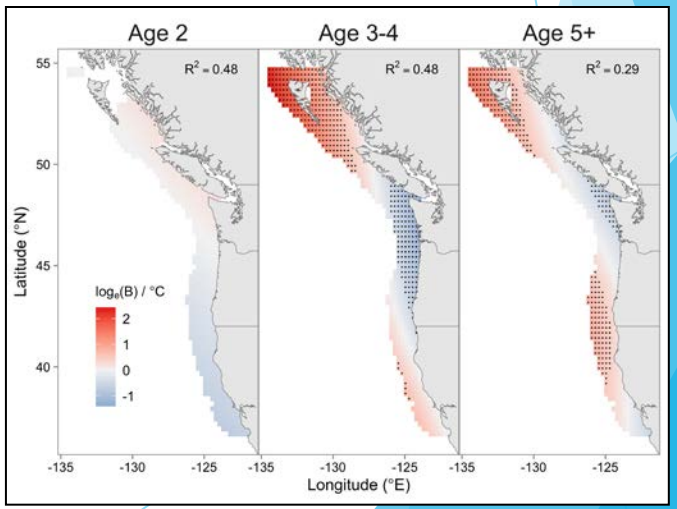
Figure from Mike Malick's talk to 2019 SRG

FATE project

Environmental drivers of Hake distribution







Seasonal forecasting of spatial distribution

Figures from Mike Malick's talk to 2019 SRG

7. Develop operating and estimation models

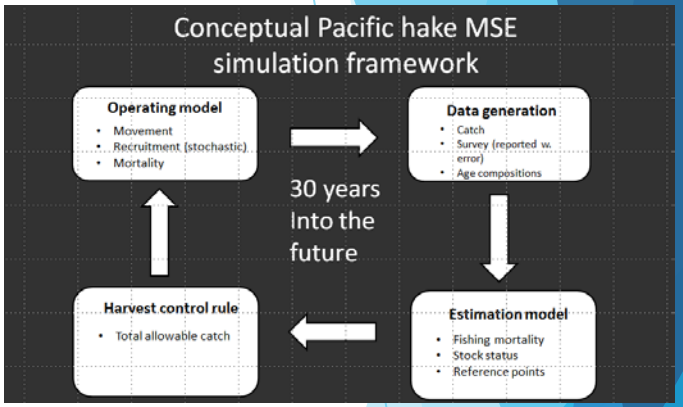
- Single operating model has been developed and conditioned relative to stock assessment model outputs
- Operating model is more complex and flexible than previous MSE
- Estimation model built (TMB program) to mimic stock assessment model (Stock Synthesis)
- Simulation framework developed by Nis Jacobsen is more flexible than past approaches so can be quickly adapted to look at alternative questions:
  - Ability to achieve management objectives
  - Technical aspects of the stock assessment
  - Utility of age-1 index
  - Survey frequency, spacing and design
  - Others…

Implement MSE simulation

8. Develop computer code for closed loop simulation
9. Parameterize operating models
10. Simulate each management strategy with each operating model and summarize and interpret performance metrics
11. Develop communication tools for simulation results

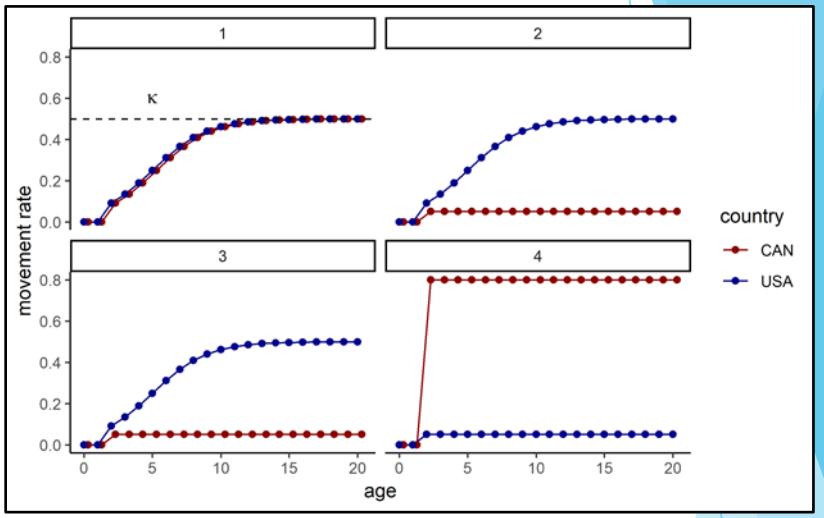
8. Develop computer code for simulations

- All main model components are coded
- Operating and estimation model contain flexible code
- Basic operating model dynamics/procedures:
  - Age-based with four seasons per year
  - Spatial-temporal components
    - Movement
    - Fisheries
    - Spawning
    - Selectivity
  - Generates simulated data similar to available data available from the fishery/survey
  - Conditioned upon available data from survey and fishery
  - Code written in R

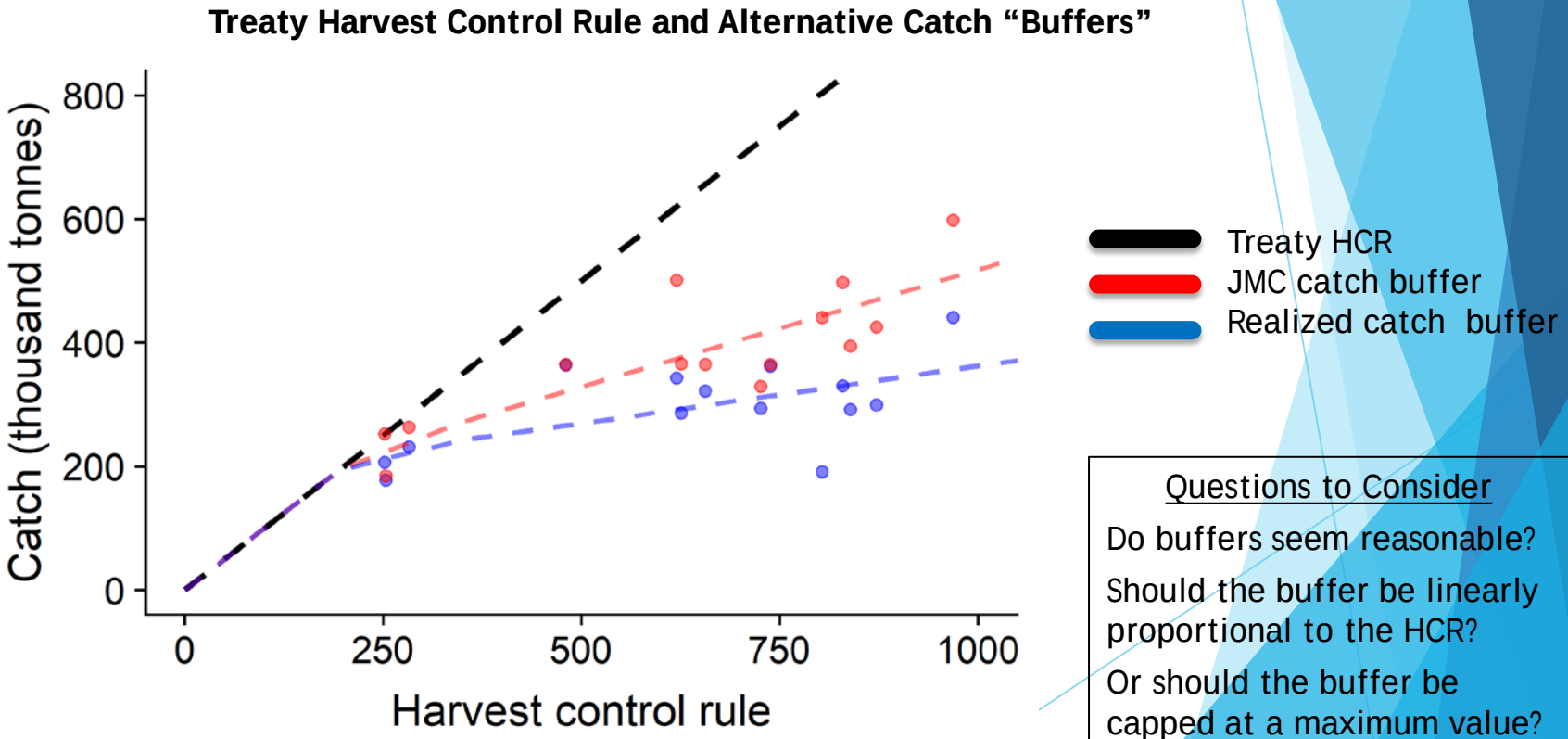


9. Parameterize operating model

- Movement
  - Pattern follows hypothesis of northward shift in summer
  - Rates tuned to make mean age and abundance in each country roughly match observed patterns
- Recruitment
  - Stock-recruitment dynamics are area specific
  - Spawning occurs at beginning of first season
- Selectivity
  - Fishing mortality in each area depends on the catch distribution per season
  - Catches occur predominantly in season 2 and 3



10. Simulate management strategies with each operating model



Questions to Consider

Do buffers seem reasonable?

Should the buffer be linearly proportional to the HCR?

Or should the buffer be capped at a maximum value?

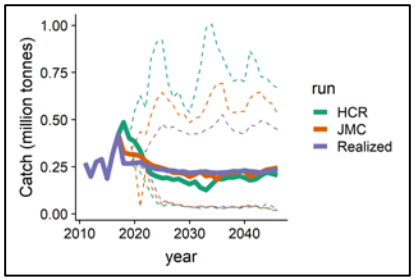
10. Simulate management strategies with each operating model

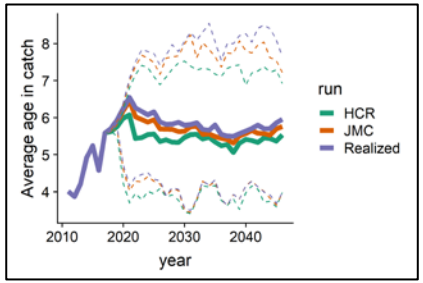
first iteration set

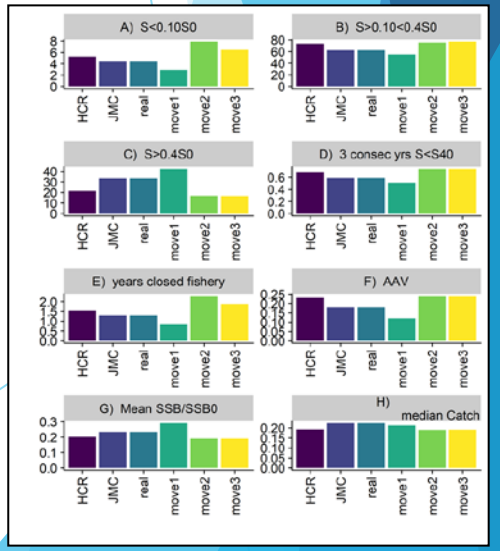
- Six different scenarios

Scenario	TAC	Movement
1	Treaty HCR	median movement rates
2	Treaty HCR with “JMC catch buffer”	median movement rates
3	Treaty HCR with “realized catch buffer”	median movement rates
4	Treaty HCR with “realized catch buffer”	low max movement rate
5	Treaty HCR with “realized catch buffer”	high max movement rate
6	Treaty HCR with “realized catch buffer”	low min age to start movement

- Results used for proof of concept and model conditioning/evaluation
- Thus far, results should not be used for informing management advice

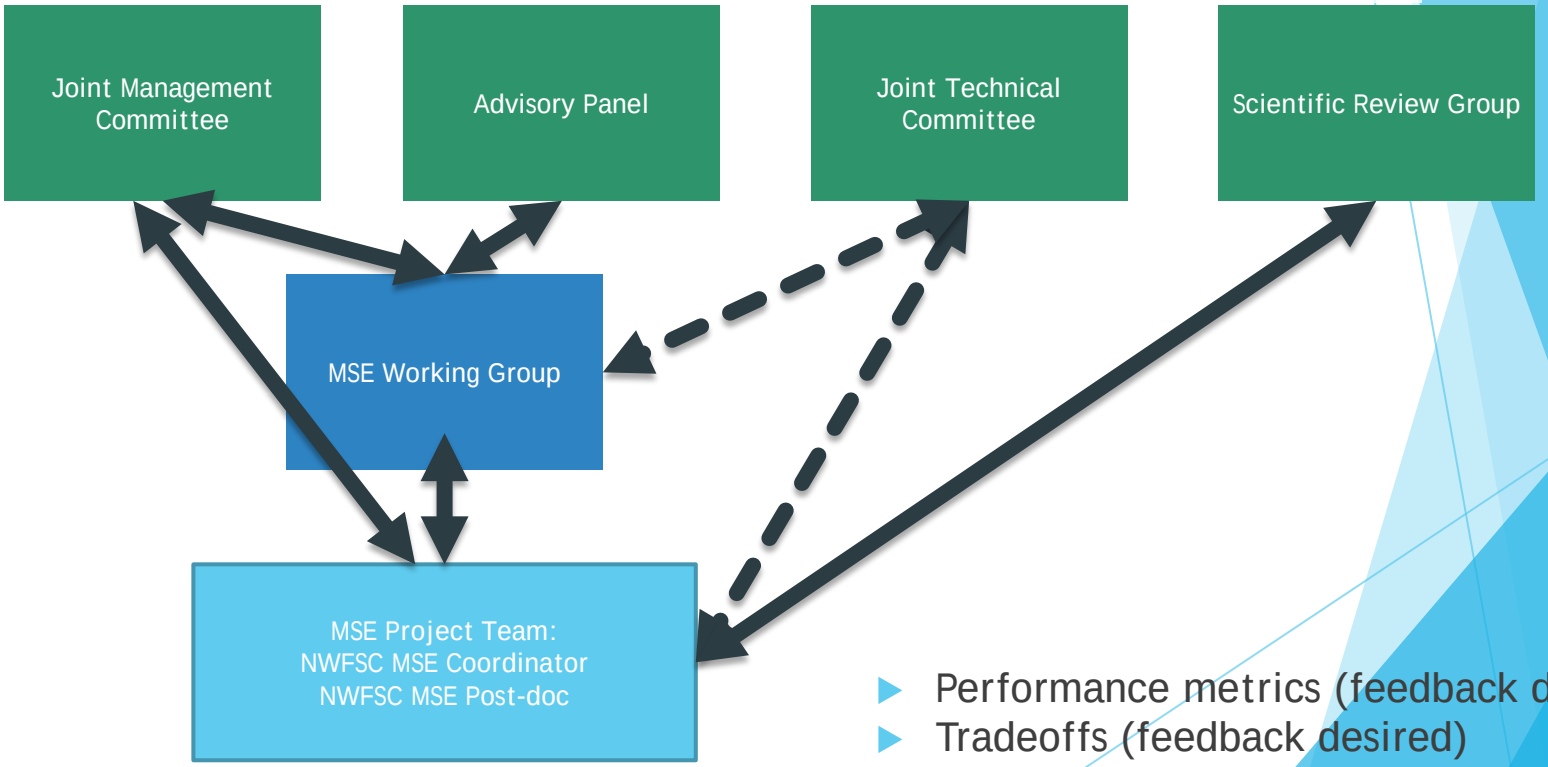






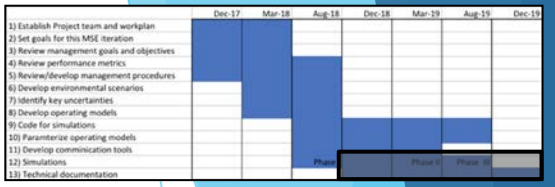
11. Develop communication tools

- Communication plan



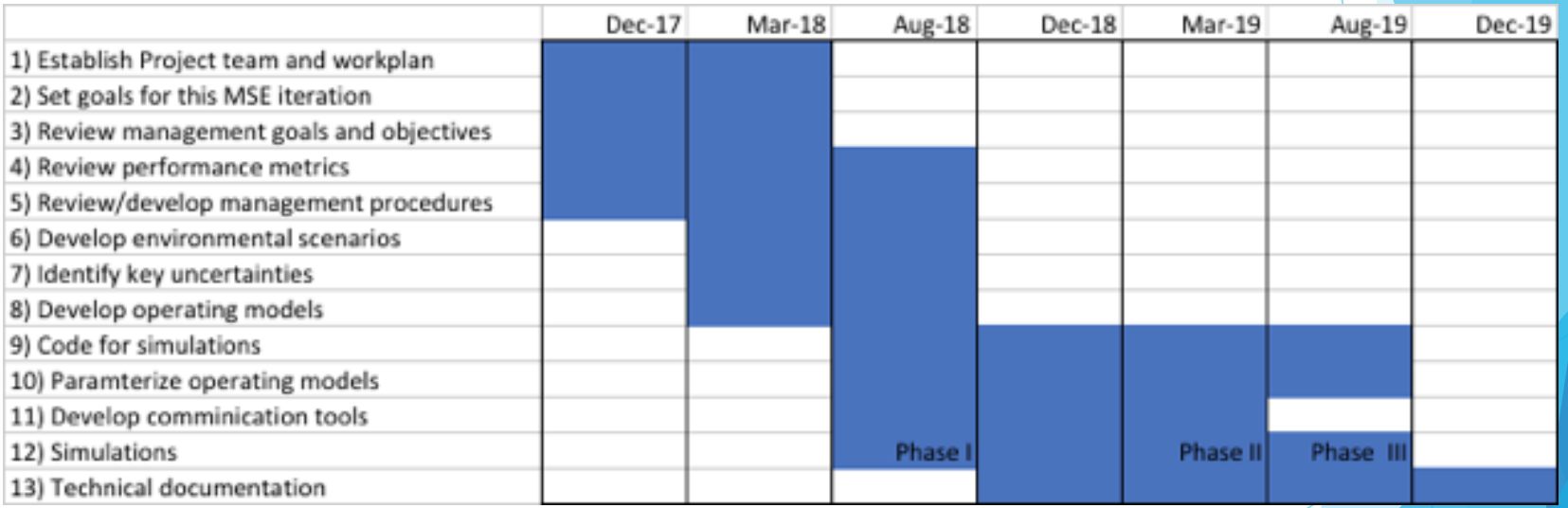
- Performance metrics (feedback desired)
- Tradeoffs (feedback desired)

Provide results of MSE simulation



12. Present simulation results
    - Deliverables:
        - First iteration, with a single non-conditioned model –JMC summer meeting 2018
        - Second iteration, with at least one conditioned model – Feb/March 2019
        - Third iteration, with multiple conditioned models – Aug 2019
13. Technical documentation of results – by Dec 2019

Next steps



Iterative process

Next steps – some specifics

- Incorporate alternative movement dynamics (e.g., time-varying movement)
- Investigate how movement influences selectivity estimation
- Test catch limits to achieve full TAC utilization for the two countries
- Time and spatially varying biological parameters

Other Questions arising from SRG meeting

- MSE objective: “minimize risk of severe overfishing and closing the fishery”, should be reworded to talk about depletion levels.

Within model quantile Management Action			5%	25%	50%	75%	95%
	Year	Catch (t)	Beginning of year relative spawning biomass				
a:	2019	0	31%	48%	64%	85%	133%
	2020	0	35%	54%	73%	98%	163%
	2021	0	37%	56%	75%	102%	173%
b:	2019	180,000	31%	48%	64%	85%	133%
	2020	180,000	31%	50%	69%	94%	159%
	2021	180,000	29%	48%	67%	94%	166%
c:	2019	350,000	31%	48%	64%	85%	133%
	2020	350,000	27%	46%	65%	90%	155%
	2021	350,000	20%	40%	60%	87%	159%
d:	2019	410,000	31%	48%	64%	85%	133%
2018	2020	410,000	25%	44%	63%	89%	154%
catch	2021	410,000	17%	37%	57%	84%	156%
e:	2019	500,000	31%	48%	64%	85%	133%
	2020	500,000	23%	42%	61%	87%	152%
	2021	500,000	13%	33%	53%	81%	153%
f:	2019	597,500	31%	48%	64%	85%	133%
2018	2020	597,500	20%	39%	59%	85%	150%
TAC	2021	597,500	9%	29%	49%	77%	151%
g:	2019	587,419	31%	48%	64%	85%	133%
FI=	2020	556,709	21%	40%	59%	85%	150%
100%	2021	470,962	10%	30%	50%	78%	152%
h:	2019	725,593	31%	48%	64%	85%	133%
default	2020	643,698	17%	36%	56%	82%	147%
HR	2021	517,858	4%	25%	45%	73%	148%
i:	2019	660,812	31%	48%	64%	85%	133%
C2019=	2020	660,812	19%	38%	57%	83%	148%
C2020	2021	526,084	5%	26%	46%	74%	147%

Not MSE-related

- Forecast catch levels used in stock assessment:
  - What catch levels should be used for forecasting?
  - Should constant catch levels be at equally spaced intervals between a lower and upper threshold?
  - Would JMC prefer a defined set of constant catch levels or change annually based on stock size and recent TAC decisions.